AUDI AG
Communication Product & Technology
D-85045 Ingolstadt
Germany
Tel.: +49 (0)841 89-32100
Fax: +49 (0)841 89-32817

September 2005

Audi Q7 hybrid

The clean way to high performance 2

Two hearts beating as one: the driveline 3

Intelligent energy management 4

Audi hybrid vehicles - 15 years of pioneering work 7

The equipment, data and prices stated here refer to the model range offered for sale in Germany. Subject to amendment; errors and omissions excepted.

Audi Q7 hybrid
The clean way to high performance

An engineering first in Frankfurt where Audi is premiering its first hybrid vehicle powered by an FSI direct-injection petrol engine. The Audi Q7 hybrid concept study is equipped with a 4.2-litre FSI V8 drive unit developing
257 kW (350 bhp) and 440 Newton metres of torque. An electric motor that has also been integrated into the driveline adds up to an extra 200 Nm of torque. The study is making its debut at the 2005 International Motor Show in Frankfurt.

It goes without saying that no Audi boasting such performance potential would be complete without quattro permanent four-wheel drive to convert all of the engine's power and torque into supreme levels of handling dynamics and driving safety. Power is directed to the wheels through a 6-speed tiptronic transmission.

The performance figures promised by the Audi Q7 hybrid give it sports car status: a mere 6.8 seconds are required to reach 100 km/h from standstill. In-gear pulling power is even more electrifying, with the SUV accelerating from 80 up to 120 km/h in 5th gear in 7 seconds flat. These compelling figures are made even more impressive by the fact that the Q7 hybrid tips the scales at 2,410 kilograms and returns fuel consumption figures of just 12.0 litres per 100 kilometres, nearly 13 percent less than the standard-production model: what better testimony to the efficiency of the Audi hybrid drive system?

The concept study's fine all-round capabilities are underpinned by the effective blend of high-performance FSI engine and electric motor, plus, not forgetting of course, the intelligent energy management at work in the Q7 hybrid. After all, it is energy management that enables optimum use to be made of each drive unit's potential, resulting in superior performance going hand in hand with maximum efficiency.

Two hearts beating as one: the driveline

When the bonnet of the Audi Q7 hybrid is first opened, there are no immediate visible signs of its hybrid nature. The 4.2-litre eight-cylinder power unit takes up the entire engine compartment, with no trace of either an electric motor or a battery.

The V8 engine is taken from the latest Audi V-engine range whose trademark characteristics include a cylinder angle of 90 degrees and cylinder spacing of 90 millimetres. A further distinguishing feature is the chain-driven camshaft. Unlike the conventionally powered models, the auxiliary air conditioning compressor and power steering pump units in the Q7 hybrid are powered electrically to ensure their continued operability when the vehicle is driving in pure electric mode.

The V8 under the bonnet of the Q7 hybrid incorporates the same FSI direct-injection petrol technology featured in the RS 4 engine. This marks the first ever use in a series-production eight-cylinder engine of a technology which has powered the Audi R8 Le Mans racing car to five victories.

FSI engines are more powerful and dynamic than conventional indirect-injection units whilst at the same time being a model of fuel economy. The V8 engine was retuned prior to being fitted in the Audi Q7. The new engine's credentials now include beefy torque delivery right up to the red line as well as agile responsiveness, all combined with economical running.

These characteristics are partnered by a prodigious output of 257 kW/350 bhp at 6,800 rpm plus a peak torque of 440 Nm at 3,500 rpm.

Placing a further 200 Newton-metres of torque and 32 kW of power on tap, the electric motor is integrated into the driveline in the ideal position, between the V8 engine and the automatic transmission's torque converter. It is linked up to the FSI engine via a separating clutch that allows the vehicle to be propelled by either one of the drive units alone or by both acting in unison.

This solution makes the most economical use possible of the space available, meaning that it does not impinge upon the passenger compartment in any way. Like the standard-production version it is derived from, the Q7 hybrid offers up to three rows of seats and a spacious luggage compartment.

The electric motor draws its energy from a battery system housed beneath the luggage compartment floor at the rear of the vehicle. A voltage transducer that supplies power to the vehicle's electrical system can also be found here. The tyre mobility system for repairing punctures has been incorporated next to the battery compartment.

When measured against earlier generations of hybrid vehicles, the electric motor and nickel-metal hydride (NiMH) battery are veritable lightweights, with the study only weighing in at 140 kilograms more than the standard-production model, an increase of less than seven percent.

Intelligent energy management

An intricate system of control electronics is required to coordinate operation of the two power units to optimum effect. In doing this, the control electronics naturally take the driver's commands into consideration, as communicated to the system with the accelerator and brake pedals and with the tiptronic selector lever, as well as the current road speed. However, the battery's charge status and the pulses transmitted by the ESP electronic stabilisation program are also vital parameters.

The electronics automatically regulate the interaction between the drive components and convert the driver's commands into a perfect synthesis of sportiness and efficiency. The occupants can follow what's happening in one of the sub-menus in the MMI Multi Media Interface display.

There are basically three different operating states: either the vehicle is driven by the combustion engine or electric motor alone, or the two power sources unite together to accelerate the vehicle. The petrol engine is responsible for basic vehicle operation, although it also energises the battery at the same time.

The electric motor, meanwhile, is capable of propelling the vehicle at speeds of up to 30 km/h, autonomously and in virtual silence, which comes in particularly handy when driving in city traffic. The result is a sharp cut in both harmful emissions and noise levels in built-up areas.

The battery's charge capacity allows for a range of up to two kilometres in pure electric mode, with the extra energy produced during braking and engine overrunning being fed back into the system. Once the battery's capacity has dropped to minimum, the combustion engine cuts in imperceptibly to recharge it.

The V8 FSI engine is able to unleash 350 bhp and 440 Newton-metres of torque. This power alone is enough to accelerate the standard-production Q7 from 0 - 100 km/h in 7.4 seconds. If the driver is looking for even snappier response, the electronics engage the electric motor too. Unlike combustion engines, the motor's additional thrust, with up to 200 Nm of torque, is available instantly when the vehicle pulls away.

Out on the road, this takes acceleration into a new dimension, particularly so at low speeds. Just four metres after starting from standstill, the Q7 hybrid is already a metre ahead of its V8 petrol-engined sibling, with the electric motor's boost effect shaving a whole 0.6 seconds off the time for the 0 - 100 km/h sprint. The auxiliary drive unit has an impressive effect on pulling power too. The vehicle accelerates from 80 up to 120 km/h, the typical step-up in speed when overtaking, a good two seconds or around 25 percent quicker. Drive power is boosted automatically the instant the driver depresses the accelerator pedal fully, with the necessary electrical energy drawn from the rear-mounted battery.

The electric motor is capable of far more than just providing auxiliary power though, as it also regenerates the kinetic energy produced by braking or driving downhill in overrun mode and feeds it back into the system to recharge the battery.

During this "recuperation" phase, the unit switches its function in a fraction of a second to act as a generator, without the driver noticing the slightest change.

An additional function for streamlining the new drive system's efficiency is just as imperceptible to the driver. If the vehicle is coasting without the accelerator pedal depressed, the combustion engine is switched off. The same fuel-saving measure is initiated whenever the vehicle is stationary for over three seconds. All the driver has to do to resume the journey is release the brake pedal and depress the accelerator and the petrol engine will immediately spring back into action.

The electric motor assumes the role of the starter-alternator unit, resulting in a quiet, smooth and extra-quick starting process.

Thanks to these strategies deployed by its intelligent energy management, the drive system boasts a high degree of efficiency. Despite its far superior acceleration, an identical top speed and the increase in vehicle weight, the Q7 hybrid burns around 13 percent less fuel than a comparable standard-production model fitted with a combustion engine only. Average fuel consumption in the MVEG cycle is 12.0 litres per 100 km. When driving purely in city traffic, where frequent energy recuperation makes even greater reductions possible, the hybrid vehicle's fuel-saving potential can be harnessed to yet greater effect.

The concept study uses sunlight as yet another source of energy: the Audi development team has integrated solar cells into the open sky system – the SUV's large-format glass sunroof – which allow the ventilation and air conditioning systems to be operated when the vehicle is parked. This represents a valuable boost to comfort, particularly on hot summer days when the driver is also able – for the first time – to activate the climate control system remotely a few minutes before starting the journey, so that passengers find a pleasantly cool interior awaiting them. Part of the battery capacity of the hybrid drive system is used in order to achieve this.

The visionary systems onboard the Audi Q7 hybrid concept study once again provide an impressive demonstration of the "Vorsprung durch Technik" philosophy that the company is so renowned for. It is a technological pioneer that showcases solutions to not just one but several of the most pressing challenges facing tomorrow's automotive society, fusing as it does so motoring pleasure with rationality, supreme comfort and maximum efficiency.

Audi hybrid vehicles - 15 years of pioneering work

To this day, Audi remains the first European manufacturer to have series-manufactured a hybrid vehicle, an honour it has held since 1997 when it brought out the Audi duo based on the A4 Avant. Drive power was provided by a 1.9-litre TDI engine developing 90 bhp assisted by an electric motor with a further 29 bhp. Both delivered their joint drive power to the front wheels, with a lead-gel battery at the rear of the vehicle providing the necessary electrical energy.

The first ever generation of the Audi duo was actually unveiled as early as 1989, however. The experimental vehicle built on the platform of an Audi 100 Avant quattro was equipped with a 12.6-bhp electric motor which was responsible for driving the rear wheels instead of the propeller shaft. Energy was sourced from a nickel-cadmium battery. A 2.3-litre five-cylinder engine delivering 136 bhp powered the front wheels.

Just two years later, Audi developers revealed the second generation of the duo, likewise in the guise of an Audi 100 Avant quattro. The electric motor, a 28.6-bhp AC unit, once again propelled the rear wheels. This time however, a Torsen differential was included to route extra power to the rear wheels from the two-litre four-cylinder engine up front.

Throughout the many years of development, Audi engineers have carried out pioneering work that has played a key role in the advancement of hybrid technology up to full production maturity. This applies both to overall concept development and to more specialist areas, such as their work on sophisticated battery technology as well as on the highly advanced energy management system that is now at the heart of the Audi Q7 hybrid.